

Form ESA-B4. Summary Report for ESA-072-3

Public Report - Final

Company	Kraft Waupaca	ESA Dates	May 6-8, 2008
Plant	Waupaca, WI	ESA Type	Compressed Air
Product	Feta and Processed Cheeses, Hummus and other food products	ESA Specialist	Greg Wheeler

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

The Kraft Foods plant in Waupaca, WI, makes a variety of branded and private label specialty foods and cheeses, including feta and processed cheeses and hummus.

Objective of ESA:

The objective of the ESA is to model the compressed air system using the AIRMaster+ software tool and to use the tool to identify savings from several measures that would improve system efficiency. It is not the objective of the ESA to look at all potential plant improvement opportunities.

Focus of Assessment:

The focus of the ESA is for plant personnel to understand how the appropriate DOE tool can be applied effectively in the plant. The focus of this ESA is the main compressed air system.

The compressed air system includes:

Compressor Summary						
#	Manufacturer	Model	acfm	hp	Type	Control
North	Gardner Denver	EHF-99A	749	150	2-stage Lube-free screw	Load-Unload
South	Gardner Denver	EHF-99A	749	150	2-stage Lube-free screw	Load-Unload
System Totals			1,498	300		

Compressors are approximately 3 ½ years old and operate efficiently in load-unload mode with an auto-off timer that turns off compressors when they are not needed. A glycol loop to an evaporative condenser cools oil, inter-stage and discharge air.

Dryer Description. A single twin-tower desiccant dryer provides air with a -80 F dew point. A 7.5 hp blower provides heated air (23 kW) to regenerate the desiccant beds on a timed cycle. The dryer has an energy management control option to optimize air drying with varying temperature and humidity conditions.

Dryer Summary				
Qty	Manufacturer	Model	scfm	Type
1	Gardner Denver	DPB-1300	1300	Desiccant with heated blower regeneration

Distribution system description. The plant includes a 600 gallon wet receiver in the compressor room, an approximately 4,000 gallon dry receiver outside of the compressor room, and a 200 gallon secondary receiver above the production floor. Distribution piping with headers from 3” down to 1 ½” typically yield approximately 1 psi pressure drop from the compressor room to production line #6.

Control system description. The compressors are controlled internally with an auto-off timer. An external PLC sequencer changes sequence order twice per week to balance compressor use.

Approach for ESA:

1. Identify and understand the compressed air system(s) and determine priorities for opportunities to pursue.
2. Identify critical airflows, pressures, end uses, temperatures and other information that will be required for the analysis.
3. Gather available data and trend logs and develop a list of data that needs to be obtained from other sources or that needs to be measured or logged.
4. Reduce and enter this data into the AIRMaster tool and check for internal consistency, such as with metered energy use. Data will be verified and adjusted, if necessary. Team members will enter data into the AIRMaster tool and check results for feasibility.
5. Acquire cost estimates from vendors if possible. Estimate range of improvement costs from previous plant and Qualified Specialist experience.
6. Demonstrate AIRMaster to interested participants.
7. Complete:
 - Plant Intake Questions
 - Summary Report
 - Software Tool Output
 - Evaluation

General Observations of Potential Opportunities

Energy Use Summary:

Energy Use Summary					
Source	Annual Use	Units	Unit Cost	10 ⁶ Btu	Annual Cost
Natural Gas	17,181	10 ⁶ Btu	\$7.000	17,181	\$120,267
Electricity	3,218,611	kWh	\$0.0500	10,985	\$160,931
Total				28,166	\$281,198

- Note what you would expect would be Near Term, Medium Term, Long Term opportunities. See definitions below:
 - ❑ Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
 - ❑ Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
 - ❑ Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

- Estimate, if possible, the identified % plant fuel savings from a) Near Term opportunities; b) Medium Term opportunities, c) Long Term opportunities.
- Estimate, if possible, the identified % electricity savings from a) Near Term opportunities; b) Medium Term opportunities, c) Long Term opportunities.

Results.

The following results and recommendations represent the best information available at the time. When current compressor design, performance specs, or fan curves were not available, they were estimated and scaled from generic specs and curves in AirMaster. Compressor current was measured with clamp-on ammeters for loaded and unloaded conditions and recorded with data loggers for one week at 6-sec intervals. Motor efficiency and power factors and full load and 25% load were taken from MotorMaster+ 4.0. Compressor power was then calculated for each logged data point.

Power for both compressors, as well as two pressure sensors, was imported into LogTool and graphed. Three daytypes were selected: Level 1 (full production), Level 2 (partial production); and Level 3 (shutdown and start-up day). The results and estimated savings are reasonable, but the plant team recommends getting more long-term operating data and equipment specs before modifying the compressed air system based on these results.

AIRMaster recognizes that compressors operate most efficiently at full load and therefore models air systems by base loading compressors in the specified sequence order. The remaining partload air requirement is placed on a single compressor.

Results from the following four (4) Energy Efficiency Measures (EEM), from the scenarios “Compressed Air Strategy” and “Reduce Pressure” in AIRMaster, are included.

		Savings/yr		
Identified Opportunity	kWh	Total \$	Imp Cost	Payback (years)
Reduce Air Leaks	60,700	3,900	3,000	0.8
Improve End Use Efficiency	16,300	1,200	3,000	2.5
Reduce System Air Pressure	34,700	2,700	150	0.1
Reduce Pressure During Cleanup	13,500	600	150	0.3
Total	125,200	8,400	6,300	0.8

1. Reduce Air Leaks (savings 1.9% of plant electricity use, 11.8% of compressor use, Near Term)

Situation: Air leaks can be heard and felt at several locations in the plant. Some leaks are in valves, hoses and fittings that are easily repaired. Others are in cylinders or other equipment that will need to be replaced or rebuilt and are more expensive to repair. Air leaks were measured from logged data before shutdown to be approximately 130 acfm.

Solution: Tag and repair air leaks. An air leak generally costs around \$1000/year at \$0.06/kWh by the time it can be heard. Fixing leaks is generally low cost in both time and materials, with paybacks typically less than one-year. Plant personnel estimated that air leaks could be reduced by 50% (approximately 65 acfm).

Savings: The plant air system operates 6,864 hours/year. The plant has a leak tag and repair program and plans to purchase an ultrasonic leak detector. AirMaster calculates savings to be \$3,900/yr with a 0.8 year payback.

2. Improve End Use Efficiency. (savings 0.5% of plant electricity use 3.2% of compressor use, Near Term)

Situation: Plant currently has several end uses that could be performed more efficiently. Examples:

- 4 vibrators that shake crumbled cheese to settle in tubs use 7.7 scfm each at 60 psig. Plant personnel estimated that vibrators operate on a 60% duty cycle (3 sec on, 2 sec off), total average airflow would be 19 scfm.
- 2 seal air jets blow cheese particles off tub lips before seals are applied. Both jets have a combined 130 drilled holes with diameter of 0.070" in a 1/2" stainless steel header. Pressure is delivered at line pressure through 6' of 1/4" tubing. Rough calculations show approximately 1 cfm/hole, limited by an approximate 90 psi pressure drop through the 1/4" tube that feeds the header. Total airflow is estimated to be approximately 130 scfm.
- Boiler fire eye has compressed air cooling through 8 feet of 1/4" open tubing, with pressure at the inlet reduced to 8 psig. Airflow is estimated at 7 scfm.

Solution: Total airflow for these 3 applications is approximately 150 scfm. Solutions for each application would include:

- Replace 4 vibrators with either electric vibrators (estimate 500 watts total electric power) or smaller or more efficient vibrators that would use less air. Savings would depend on which model or size would perform satisfactorily.
- Seal jets would use approximately 50% of current air use by operating intermittently when cups are passing or by building a header with engineered nozzles or knives.
- The boiler fire eye would only need cooling when the boiler turns off. Add a solenoid valve to stop airflow when boiler is operating and a time-delay relay or temperature sensor to turn off airflow after boiler cools to acceptable level. Cooling a fire eye is unusual. Alternately, pursue other means to extend fire eye life.

The first two applications would reduce airflow during level 1 and level 2 production. The third application would reduce airflow during all plant operating hours. We believe that airflow might be reduced by more than 75 scfm, however we will make a conservative estimate that airflow can be reduced by 30 scfm during levels 1 and 2 production.

Savings: Assuming leaks are reduced by 50%, we estimate that plant air use can be further reduced by 30 cfm for 16 hours/day for each level 1 and level 2 production day. AIRMaster calculates savings to be approximately \$1,200/yr. Plant personnel estimated cost to be \$3,000 with a 2.5-year payback.

3. Reduce System Pressure (savings 1.1% of plant electricity use, 6.7% of compressor use, Near Term)

Situation: The compressors currently operate at loading and unloading between 95 and 105 psig. After filters and dryers, air is supplied to the plant at approximately 1 psi lower. While some of the packaging equipment is believed to require 90 psig, other machines are rated at 85 and 80 psig. Other air uses, such as vibrators operate at 60 psig.

Solution: Consider reducing the discharge pressure at the compressors by 10 psi. Begin by reducing pressure in small steps, such as 1 psi, and continue if there are no problems. If a problem arises, consider the cost of resolving the problem versus the savings from reducing pressure. For example, adding another secondary receiver near an end use to meet an intermittent load, closing a piping loop, or adding a dedicated or booster compressor to satisfy a critical or higher pressure load.

Savings: Savings are approximately ¾% for each psi that pressure can be reduced, including power savings and reduced airflow. AirMaster calculates savings from reducing system pressure 10 psi to be approximately \$2,700/yr (\$270/psi reduction). We assume a minimal cost of \$150 to change the pressure setpoint of the control system with a 0.1-year payback.

4. Reduce Pressure During Cleanup (savings 0.4% of plant electricity use, 2.6% of compressor use, Near Term)

Situation: Cleanup requires compressed air for handheld wands with nozzles (30 psig) and for foaming cleaning chemicals (60 psig). Cleanup occurs approximately 8 hours per day for each daytype. We further assume that system pressure has been reduced by 10 psi (85 to 95 psig).

Solution: Consider reducing the discharge pressure at the compressors by an additional 25 psi during cleanup.

Savings: Savings are approximately ¾% for each psi that pressure can be reduced, including power savings and reduced airflow. AirMaster calculates savings from reducing system pressure an additional 25 psi during cleanup to be approximately \$600/yr. No demand savings are included. We assume a minimal cost of \$150 to change the pressure setpoint of the control system with a 0.3-year payback.

Operation and Maintenance Opportunities

Operation and Maintenance
1. Consider reducing pressure further as older critical equipment is replaced
2. Verify that desiccant dryer regeneration is set to the efficient energy management setting (initiate regeneration on dewpoint), regeneration terminates on tower temperature, and seasonally reset dewpoint setpoint when danger of freezing is past,
3. Consider adding solenoid valves interlocked to primary machines to turn off air when machine is down.
4. Add solenoid valve to boiler fire eye cooling air to stop airflow when boiler is operating and a time-delay relay or temperature sensor to turn off airflow after boiler cools to acceptable level. Cooling a fire eye is unusual. Alternately, pursue other means to extend fire eye life.

Other Measures Considered but not Recommended

OMC 1. Valve off Departments. (savings 0.3% of plant electricity use 2.2% of compressor use, Near Term)

Situation: We considered valving off approximately half of the departments (processing lines) when operating at lower production levels (Level 2 daytype such as Saturdays) and cleanup/sanitation times. From logged data, approximately half as much air was used on Saturday compared to full production. We measured air use on down days to be approximately 130 acfm, and assume that will be reduced by half with the leak repair program. If we assume Level 2 production to be half of full production on average, then we further assume that 30 acfm (half of the remaining 65 acfm) could be valved off.

Solution: Valve off approximately half of the departments during all non-full production hours.

Savings: AIRMaster Since this occurs during off-peak hours, there are no demand savings and lower off-peak energy rates generally apply. Annual savings are approximately \$500. We estimate cost to install two solenoid valves and control switches to be \$2,000 with a 4-year payback. This is not recommended at this time due to small savings and long payback.

OMC 2. Add 75 hp swing compressor. (savings 0.6% of plant electricity use, 5.0% of compressor use, Near Term)

Situation. After leaks are reduced, inefficient uses are replaced or improved, and pressure is reduced, loads on one 150 hp compressor are generally less than 35% during level 2 partial production and less than 20% (sometimes less than 10%) during sanitation and cleanup.

Solution: Consider adding a smaller compressor for smaller demand times. Several sizes are possible. A lubricant-free screw would maintain oil-free air and be fully compatible with the existing load-unload control strategy. A 75 hp compressor was modeled because it would meet the level 2 load and improve efficiency during cleanup. A smaller compressor would operate more efficiently at a higher load during cleanup, but would not meet the current level 2 load.

Savings: AIRMaster calculates savings from adding a 75 hp swing compressor to be approximately \$1,200/yr. We estimate the cost to be \$20,000 with a 16-year payback. Therefore, we do not recommend adding a swing compressor at current operating loads.

OMC 3. Turn off Compressor. (savings 0.2% of plant electricity use 2.1% of compressor use, Near Term)

Situation: After plant is shutdown for more than one day, lines and equipment need to be sterilized before use. This must be done no more than 8 hours before production begins. It requires approximately 3 hours to complete, so that compressors might be turned off until production begins.

Solution: Turn off compressors for 5 hours each Monday morning. AirMaster would require another Monday daytype to model this change, however the 5 hours off can be easily modeled by turning off the compressors for one hour at midnight on each of five production days/week.

Savings: AirMaster assumes that airflow and pressure have already been reduced. Further, savings occur off-peak with no demand savings and off-peak energy costs. AIRMaster calculates savings to be approximately \$260/yr. There is no additional cost to turn compressors off, so payback is immediate. Turning off a compressor for 5 hours/week is not included in the recommendations because the savings are small.

Management Support and Comments:

Kraft Foods has a Sustainability Manager and a target to reduce energy use by 30% in 5 years.

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Disclaimer

The work described in this report is funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) Industrial Technologies Program. The primary objective of the Energy Savings Assessments (ESA) is to train plant personnel to use USDOE software tools to identify and evaluate Energy Efficiency Measures (EEM) that would reduce plant energy use and costs. Some EEMs may require additional engineering design and capital investment. When engineering services are not available in-house, we recommend that a consulting engineering firm be engaged to provide design assistance as needed. In addition, since the site visits by the USDOE energy experts are brief, they are necessarily limited in scope.

The energy expert believes this report to be a reasonably accurate representation of energy use and opportunities in this plant. However, because of the limited scope of the visit, the U.S. Department of Energy and the energy expert cannot guarantee the accuracy, completeness, or usefulness of the information contained in this report, nor assume any liability for damages resulting from the use of any information, equipment, method or process disclosed in this report.